

**Sexual Differences in the Proportions of Two-  
Winged and Four-Winged Individuals of  
*Psectra diptera* (Burmeister), Together  
with Five New Records (Neuroptera:  
Hemerobiidae)**

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The hemerobiid genus *Psectra*, represented by the single species *P. diptera* (Burmeister), 1839, is distributed widely over the northern Palaearctic region (Killington, 1936) and is also known from the eastern half of the Nearctic region as far south as Virginia and as far north as Ontario (Carpenter, 1940). In spite of over a hundred years of collecting in both Europe and North America, reliable records of only eighty-one specimens are available, including the five specimens newly reported in the present paper.

In addition to the rareness of encounters between individuals of this species and cognizant collectors, *P. diptera* has long excited curiosity because of a remarkable dimorphism in the structure of the wings. Macropterous specimens with four, well-developed wings are known as well as micropterous individuals in which the metathoracic wings are reduced to small scale-like structures with vestigial venation. No intermediate forms have ever been reported.

This dimorphism has, in the past, been thought to have a sexual basis (Hagen, 1866; McLachlan, 1868; Banks, 1905), while Albarda (1874) and McLachlan (1879) have suggested the possibility that two sibling species were represented. These ideas have been questioned by Mjöberg (1909), who suggested that only a single species was involved and that either sex might be either macropterous or micropterous. This idea was adopted by Killington in his treatment of the species in 1936. Tjeder (1936), after dissecting the abdomina of three specimens (1 micropterous ♂, 1 macropterous ♂, and 1 micropterous ♀), concluded that the two-winged and four-winged males belonged to the same species. Carpenter (*op. cit.*), on the basis of the

relatively abundant material examined by him in connection with his revision (44 Nearctic specimens), was able to show conclusively that both types of wings may occur in either sex. The question of whether one or two species is present has not been proved one way or the other in the sense that the presence or absence of reproductive isolation has been conclusively demonstrated. However, these recent studies have shown that, aside from the difference in the wings, the two forms have virtually identical morphology, while the scanty collection data indicate a similar geographical distribution and habitat preference as well.

TABLE I.—Summary of Reliable Records of *P. Diptera*

Source of Data	Country of Origin	♂ ♂		♀ ♀	
		Microp.	Macrop.	Microp.	Macrop.
Killington, (1946)	Ireland	2	—	—	—
	Great Britain	4	1	1	3
Fraser, (1946)	Scotland	3	1	1	—
Fraser, (1947)	Scotland	—	—	1	—
Tjeder, ( <i>in litt.</i> )	Sweden	4	4	2	1
	Livonia	—	1	—	—
	Finland	1	1	1	—
	U. S. A.	—	—	1	—
	(New Record)				
Carpenter, (1940)	U. S. A.	9	5	9	21
	& Canada				
Additional New Records	U. S. A.	2	—	1	1

The published records of specimens of *P. diptera*, which the writer feels have been reliably sexed, are summarized in Table I and are taken from the sources indicated. The ten specimens which are known from the Netherlands and which are listed by Lems (1952) are regretfully omitted because of the question of the proper sexing of several of the specimens. The data from the areas surrounding the Baltic Sea were kindly supplied *in litt.* by Mr. Bo Tjeder of Falun, Sweden, who has also made available one new record from the Nearctic region.

Carpenter (*op. cit.*) has pointed out that the material from North America may indicate that the proportion of micropterous

individuals is greater in the male than in the female. This suspicion may be made quantitative by the use of Carpenter's data plus the five new Nearctic records in a standard chi-square test of independence of sex and wing type in a four-fold table. Employing Yates' correction for continuity, such a test yields a chi-square value of 4.1350 ( $.05 < P < .025$ ), indicating that the Nearctic data are not consistent with the hypothesis that the proportions of micropterous and macropterous individuals are the same in both sexes.

This difference may also explain the sex-ratio obtaining in the Nearctic sample, where of the forty-nine specimens now known, sixteen are males and thirty-three are females. This departure from a 50:50 ratio is significant (chi-square = 5.8980,  $.02 < P < .01$ ). If, as seems probable, the micropterous form is for any reason less mobile and more inclined to remain near the ground, which is thought to be the usual adult habitat of this species (Killington, 1936; 1946), then micropterous individuals should be taken less frequently than the macropterous forms. Since, as the data indicate, the proportion of micropterous males is higher than that of the micropterous females, this should reflect itself in fewer total males being taken. The divergence from a 50:50 sex ratio would then be a measure of the difference in the probabilities of taking a micropterous or a macropterous individual.

A similar analysis of the data from the Palaearctic region is made difficult because of the smaller number of specimens involved, which makes the use of the chi-square distribution in estimating the probability of independence between sex and wing type untrustworthy. An alternative method for computing these probabilities directly has been devised by Fisher (1948). The application of this technique to these data shows that, unlike the Nearctic specimens, the data of these samples provide no justification for the conclusion that there are different frequencies of micropterous and macropterous forms in the two sexes. The actual probabilities of a fit of the given data as bad as or worse, due to chance alone, if sex and wing type are unrelated, are: for the circum-Baltic specimens,  $P = .57$ ; for the

British Isles,  $P = .30$ ; while if these two groups are pooled,  $P = 1.00$ .<sup>1</sup>

The failure of the Palaearctic sample to show sex differences in the proportions of the two types may be a reflection of true differences in the New World and Old World populations, or it may be simply a result of the small series involved. It does suggest, however, that systematists might well look for geographic or temporal variation in these proportions, since, if the type of wing is under genetic control, the equilibrium frequencies of the four phenotypes would be expected to vary with the different selective characteristics of different environments in such a way that the fitness of each population is at a maximum. The particular adaptive significance of different proportions of the two wing types in the two sexes may well lie in the interplay between adaptation to the ground cover with reduced motility and the dispersal potential of the population.

#### NEW NEARCTIC RECORDS

Groton, Conn.; June 9, 1948; Coll. Dr. Anton Jansson; in collection of Bo Tjeder, Falun, Sweden. 1 micropterous ♀.

Patuxent Wildlife Refuge, Prince Georges Co., Md.; May 15, 1949; swept from grass or sedge of an improved pasture; Coll. H. B. Owens. 1 micropterous ♂.

College Park, Prince Georges Co., Md.; May 22, 1954; Coll. B. Walton. 1 micropterous ♀.

These last two specimens are in the collection of the Department of Entomology, University of Maryland, College Park, Md. The following two specimens are in the collection of the writer:

Dayton, Howard Co., Md.; July 11, 1955; found caught in a second-story window screen by front porch light; Coll. E. MacLeod. 1 macropterous ♀.

Hawksbill Mountain, elevation 3600', Shenandoah National Park, Va.; September 12, 1956; on ground in mountain meadow; Coll. C. Clifford. 1 micropterous ♂.

<sup>1</sup> This result follows from the conditions of the test in which the marginal totals of the four-fold table are held constant, and the probabilities of all possible arrangements of the data giving these totals are computed. In the case here, the actual data provide the best fit. All other possible arrangements are worse.

The third and fourth specimens listed above are interesting in that both of these were taken by a light at night, which may indicate a positive phototactic response common throughout the Hemerobiidae, but heretofore unreported for *P. diptera*. This suggests that an improved collection technique for this species might be to place a low, portable light source on the ground in an appropriate adult habitat such as that described in some detail by Killington (1946). With this arrangement, it may be possible to collect greater numbers of adults during the proper season.

The macropterous ♀ from Dayton, Md., is also interesting regarding the question of whether or not this species is capable of flight. Killington (1936; 1946) has stated that even in the macropterous form flight would seem to be impossible, basing this opinion on his observations of a living micropterous ♀ and on the slight thickening in texture of the forewing which is observed on most specimens. Although the Dayton ♀ may have walked up the front of the house to the second-story light near which she was taken, there seem to be reasonable grounds for the suspicion that some individuals of *P. diptera* are able to fly.

Killington (1946) has also raised the question of the size of our Nearctic specimens, stating that the average length of the forewing given by Carpenter (*op. cit.*) as 6 mm. seems large and suggesting that this may actually refer to the total wing span. To partially clarify this question ten Nearctic specimens (consisting of 4 macropterous and 6 micropterous individuals) were measured with an ocular micrometer. The following results were obtained:

Average length of forewing	$3.82 \pm 0.25$ mm.
Average total wing span ( $2 \times$ forewing length + body width at mesothorax)	$8.57 \pm 0.54$ mm.

As is indicated by the rather large standard errors of these means, the sizes of the individuals of this series are somewhat heterogeneous. A rather suggestive result is obtained if the mean forewing length of the macropterous specimens alone ( $4.70 \pm 0.16$  mm.) is compared to the mean forewing length of the micropterous specimens ( $3.23 \pm 0.09$  mm.). A *t* test of these results yields  $t = 8.4777$  and a corresponding *P* of  $< .001$ .

The possibility is strongly suggested by this short series that the wing dimorphism of *P. diptera* is correlated with size.

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